(12) UK Patent Application (19) GB (11) 2 217 925 (13) A

(43) Date of A publication 01.11.1989

(21) Application No 8909313.2

(22) Date of filing 24.04.1989

(30) Priority data
(31) 63100694 (32) 22.04.1988 (33) JP

(71) Applicant
Aisin Seiki Kabushiki Kaisha

(Incorporated in Japan)

1 Asahi-machi, 2-chome, Kariya city, Aichi Pref, Japan

(72) Inventors
Akio Inagaki
Kiyotaka Nakai
Hitoshi Tauchi

(74) Agent and/or Address for Service
Serjeants
25 The Crescent, King Street, Leicester, LE1 6RX, United Kingdom

(51) INT CL⁴
H02N 2/00

(52) UK CL (Edition J)
H2A AGE
H4J JCD J30X J31R J31V

(56) Documents cited
EP 0222394 A2

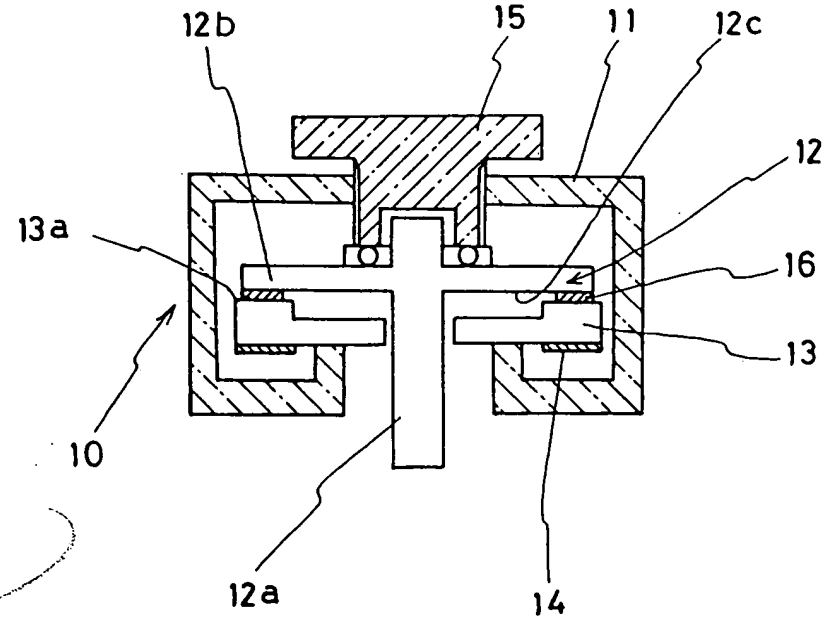
(58) Field of search
UK CL (Edition J) **H2A AGB AGE**
INT CL⁴ **H02N 2/00**

U.S Wave Motor

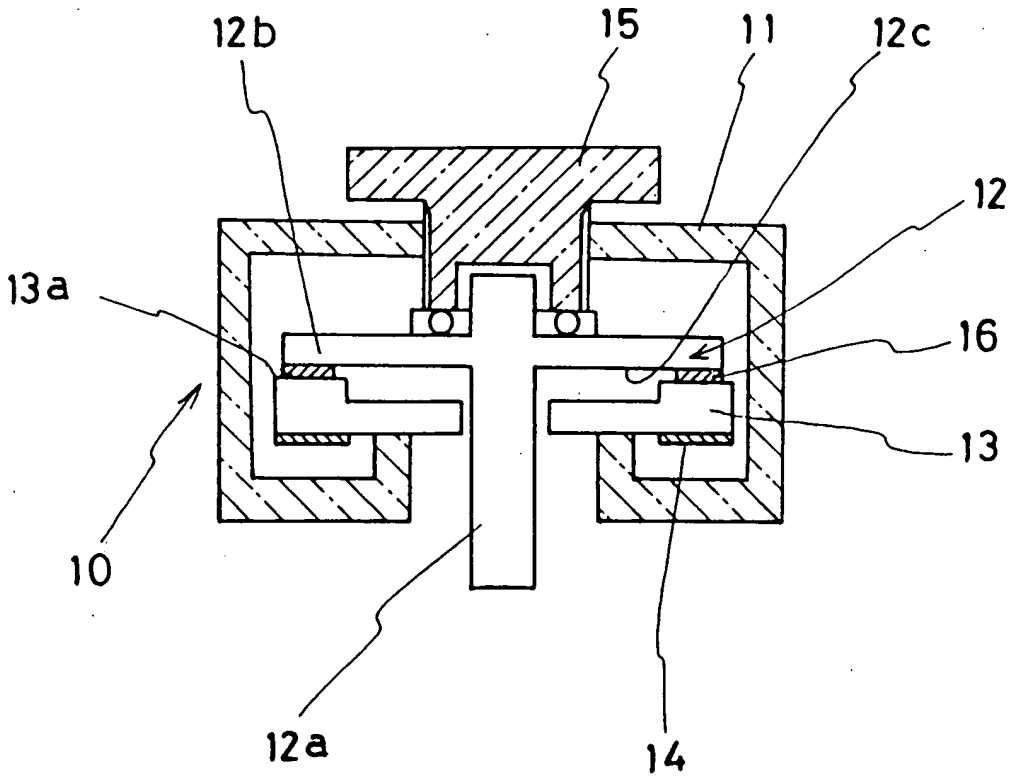
Materials

(54) **Piezo electric vibration wave motor with anti-frictional wear sheet**

(57) A vibration wave motor 10 has a sheet member 16 secured to either the upper surface 13a of the stator 13 or the lower surface 12c of the rotor 12 to prevent wear between the surfaces, the sheet member 16 comprising a base member with ultra heat-resisting property, a fluorine containing resin and a fibrous filler. The base member is suitably a polyester-ether-ketone resin or a polyester-ether-sulphone resin. The filler may be aromatic polyamide fibres or potassium titanite fibres. Preferably the fluorine containing resin is present in an amount of at least 10 parts by weight but less than 80 parts by weight per 100 parts by weight of the base member.



310/323.11


12b
15
11
12c
12
13a
16
13
10
12a
14

TITLE:

Vibration Wave Motor

DESCRIPTION:

The invention relates to a vibration wave motor driven by a travelling vibration.

In general, a vibration wave motor includes a stator at which travelling vibration is generated and a rotor to be rotated by the travelling vibration, the rotor being rotatably mounted on the stator. To obtain smooth rotation of the rotor without noise, a sheet member is disposed between the stator and the rotor.

However, some conventional sheet members are insufficiently durable against friction and some conventional sheet members damage a surface of the rotor or the stator.

According to the invention, a vibration wave motor comprises a stator with an upper surface at which a travelling vibration is generated; a rotor with a lower surface rotably mounted on the upper surface of the stator; urging means for applying a frictional force between the upper surface of the stator and the lower surface of the rotor; and a sheet member secured to either the upper surface of the stator or the lower surface of the rotor, the sheet member comprising a base member with ultra heat-resisting property, a fluorine containing resin and a fibrous filler.

The sheet member preferably contains at least ten parts by weight but less than eighty parts by weight of the fluorine containing resin per hundred parts by weight of the base member. Suitable base members include polyester-ether-ketone resin and polyester-ether-sulphone resin. Aromatic polyamide fibres and potassium titanite fibres are suitable as the filler.

The invention is illustrated by the accompanying drawing, which is a cross-sectional view of a vibration wave motor according to one embodiment of the invention.

Referring to the drawing, a vibration wave motor 10 has a casing 11 within which is a rotor 12 having a shaft 12a and an annular portion

12b in the form of a circular plate. The annular portion 12b of the rotor 12 is rotatably mounted on a stator 13 connected to a piezoelectric member 14. Upon energization of the piezoelectric member 14, a travelling wave or a travelling vibration is generated at the stator 13, thereby rotating the annular portion 12b of the rotor 12 about the shaft 12a thereof. As is well known, a frictional force is applied between the rotor 12 and the stator 13 by an urging means 15. For preventing frictional wear between a lower surface 12c of the rotor 12 and an upper surface 13a of the stator 13 without decreasing the frictional force therebetween, a sheet member 16 is utilized. This is secured to the lower surface 12c of the rotor 12. A plurality of sheet members of different composition is available as described hereinbelow.

To produce the first embodiment of the sheet member 16 40 parts by weight of a fluorine containing resin (supplied by Asahi Glass Co. Ltd.) and 10 parts by weight of an aromatic polyamide fibre (supplied by Dupont as KEVLAR) which is in the form of 1mm pulp are mixed with 100 parts by weight of a polyester-ether-ketone (PEEK) resin (supplied by Sumitomo Chemical Co.,Ltd as 450G) as a base resin or member. This mixture is then formed into a flat plate through an injecting process and the resulting plate 16 is secured to the lower surface 12c of the rotor 12 using an epoxy bonding agent (supplied by CIBA-GEIGY as XD-911). After secural, the remaining surplus portion of the sheet member 16 with respect to the portion 12b is cut away so that the outer peripheries of the sheet member 16 and the annular portion 12b coincide.

After assembly of the vibration wave motor, the starting-torque, the rotational number of the rotor 12 without load and the efficiency defined by a ratio of a mechanical output to a voltage applied to the piezoelectric member 14 are measured. Further, the wear of the upper surface 13a of the stator 13 and the sheet member 16 is measured after 1000 operations of the motor 10 (each operation consists of driving the motor 10 for one minute under a load of 4 kgf .cm and apparent rotational number of 100 rpm followed by three minutes in which the motor 10 is not driven). The results are

TABLE 2

TEST RESULTS

Embodiment No.	Starting torque (kg-cm)	non-load rotating Ns.(rpm)	efficiency (%)	wear of sheet (μ)	wear of stator (μ)	evaluation
1	10.9	160	39	3.8	0.2	0
2	10.2	155	36	7.4	0.3	0
3	10.6	158	36	2.9	0.2	0
4	9.8	149	34	6.6	0.1	0
5	10.3	152	37	5.8	0.4	0
Comparative 1	6.4	108	26	4.0	0.1	X
Comparative 2	11.2	163	37	12.4	0.7	X
Comparative 3	9.2	140	31	33.6	0.9	X
Comparative 4	10.8	160	33	21.4	102.6	X

As is apparent from Table 2, the following results are obtained.

(1) By adding the fibre in the sheet member which is in sliding engagement with the upper surface of the stator, frictional force therebetween is increased, thereby increasing the starting torque.
(2) By employing resin with ultra heat-resisting property as a base member, the life of the motor per se can be prolonged.
(3) By adding fluorine containing resin in the sheet member, the frictional durability of the sheet member can be increased.

TABLE 1

COMPOSITON (parts by weight)

Embodiment No.	Base Member				fluorine containing resin	Filler		
	PEEK resin	Polyether Sulphone resin	BT resin	polyamide resin		Aromatic Polyamide Fibres	Potassium Titanite Fibres	Silica Powder
1	100	0	0	0	40	10	0	0
2	100	0	0	0	10	5	0	0
3	100	0	0	0	40	5	0	0
4	0	100	0	0	40	10	0	0
5	0	100	0	0	40	0	10	0
Comparative 1	100	0	0	0	80	10	0	0
Comparative 2	100	0	0	0	5	10	0	0
Comparative 3	0	0	100	0	0	50	0	0
Comparative 4	0	0	0	100	0	0	0	10

given in Table 2.

In addition to the first embodiment described above, four additional embodiments and four comparative examples are illustrated in Tables 1 and 2.

CLAIMS:

1. A vibration wave motor comprising:

a stator with an upper surface at which a travelling vibration is generated;

a rotor with a lower surface rotatably mounted on the upper surface of the stator;

urging means for applying a frictional force between the upper surface of the stator and the lower surface of the rotor; and

a sheet member secured to either the upper surface of the stator or the lower surface of the rotor, the sheet member comprising a base member with ultra heat-resisting property, a fluorine containing resin and a fibrous filler.

2. A vibration wave motor according to claim 1 in which the base member is a polyester-ether-ketone resin.

3. A vibration wave motor according to claim 1, in which the base member is a polyester-ether-sulphone resin.

4. A vibration wave motor according to any preceding claim in which the sheet member contains at least ten parts by weight but less than eighty parts by weight of the fluorine containing resin per hundred parts by weight of the base member.

5. A vibration wave motor according to any preceding claim in which the filler is aromatic polyamide fibres.

6. A vibration wave motor according to any of claims 1 to 4 in which the filler is potassium titanite fibres.

7. A vibration wave motor according to claim 1 in which the sheet member has the composition set out in any one of embodiments 1 to 5 in the Table herein.